TES ozone and CO data for future model evaluation

Combo simulations to look at the effect of changes in the stratospheric ozone (flux) on tropospheric ozone since 1970

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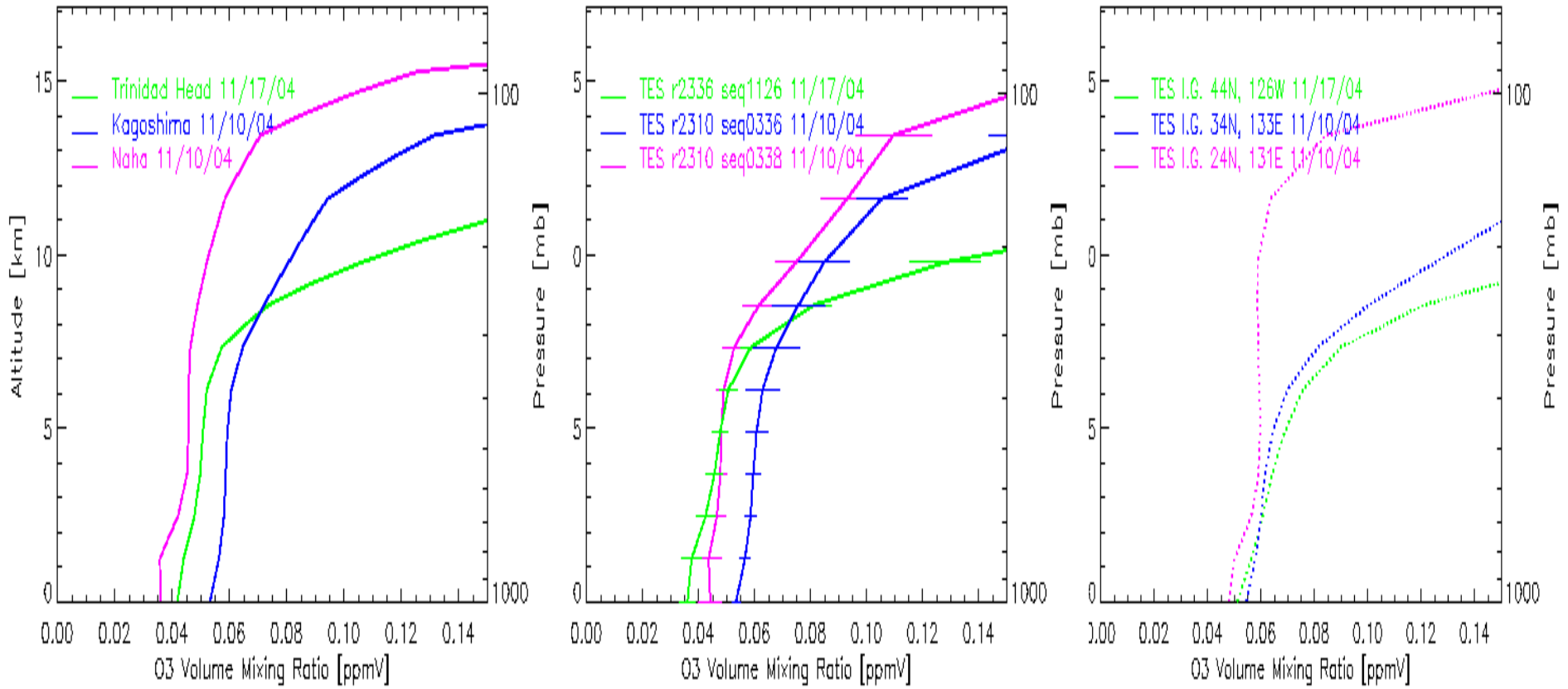
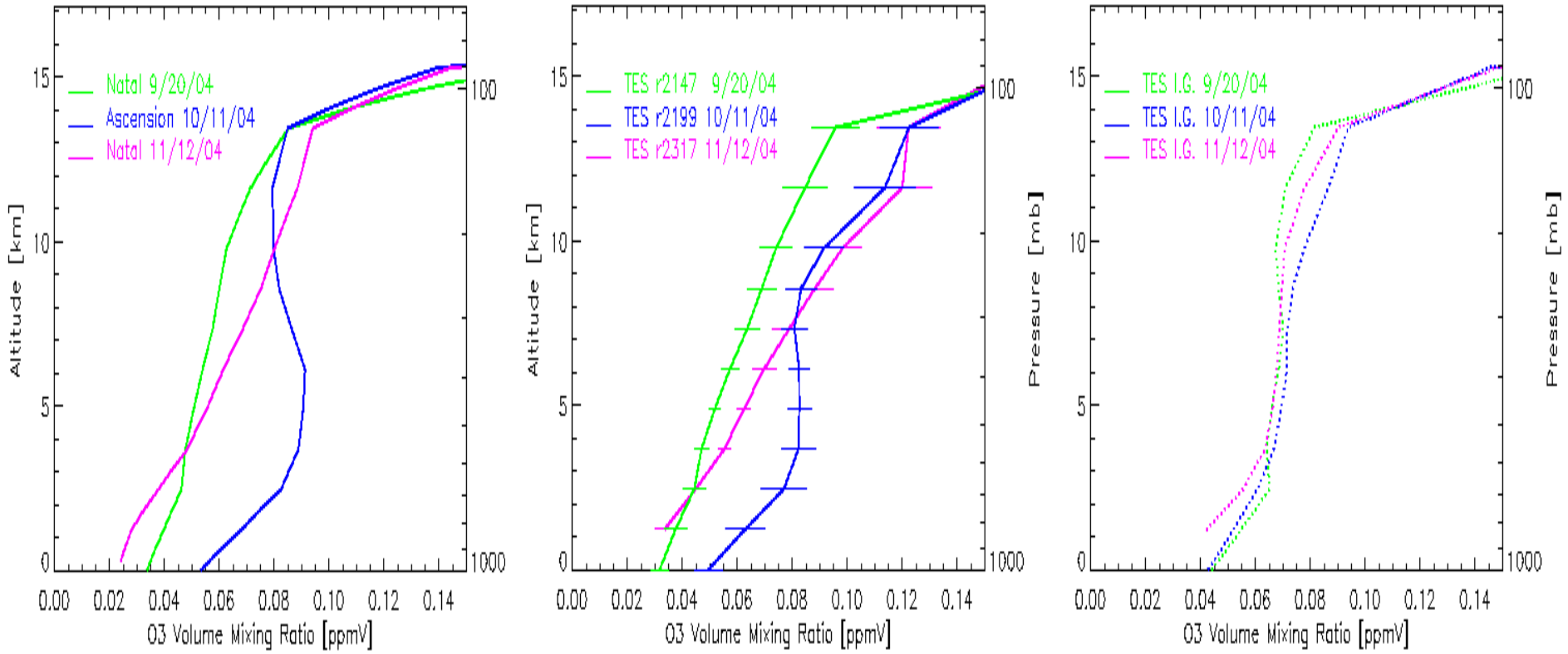
With acknowledgements to the entire Science Team, 1988-present

Comparison of 3 sonde profiles (with TES AK) and 3 TES retrieved profiles - sub-tropics/mid-latitude



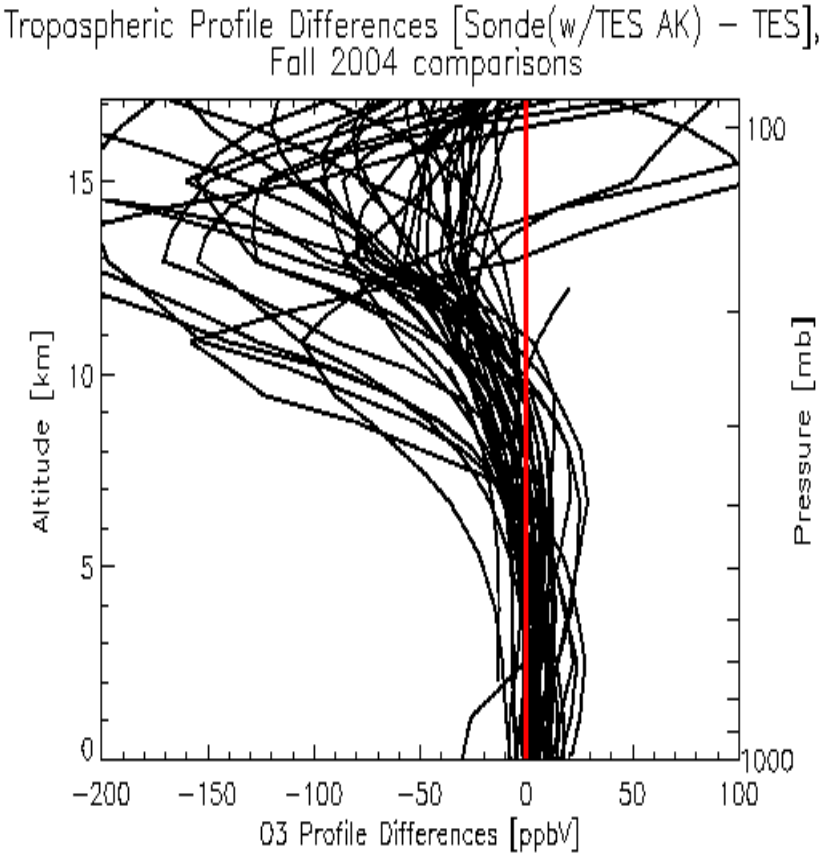
sonde TES retrieval initial guess

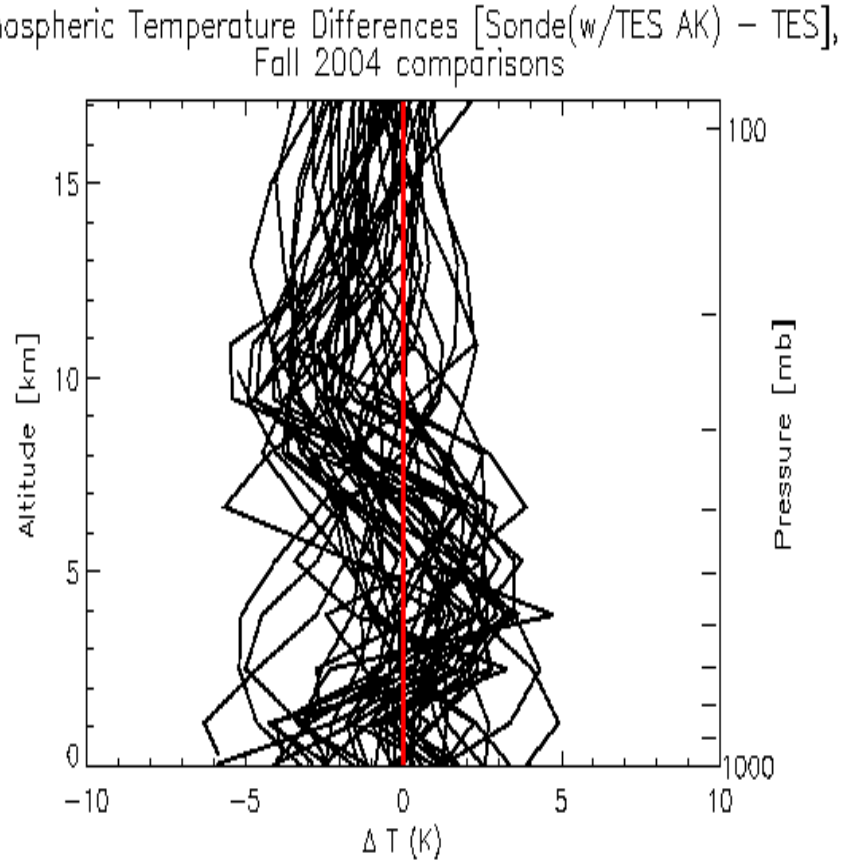
Comparison of 3 sonde profiles (with TES AK) and 3 TES retrieved profiles - tropics



sonde TES retrieval initial guess

Sonde (w/TES AK) - TES comparisons: Ozone and Temperature profiles



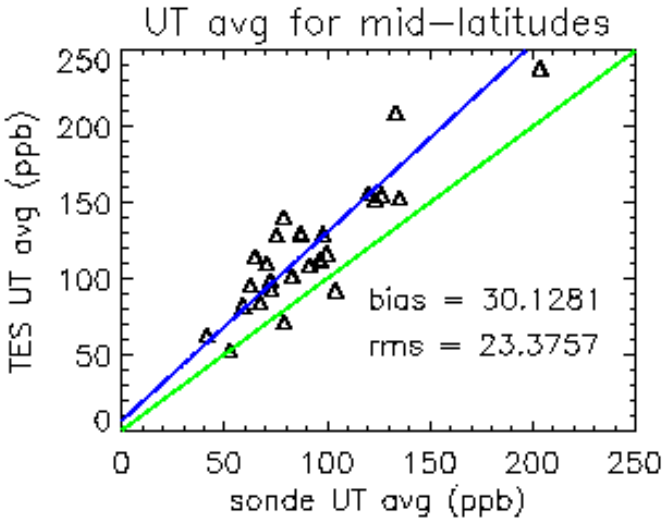


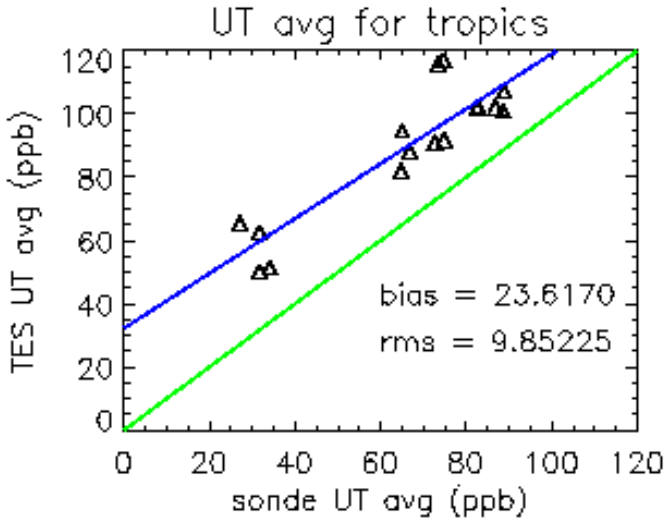
TES vs. sonde O3 averages for mid-lat & tropics

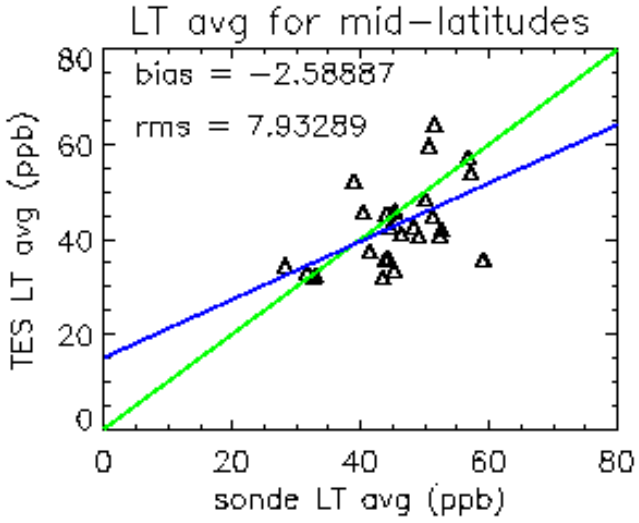
Upper Trop (UT)
500mb>p>p_{TP}

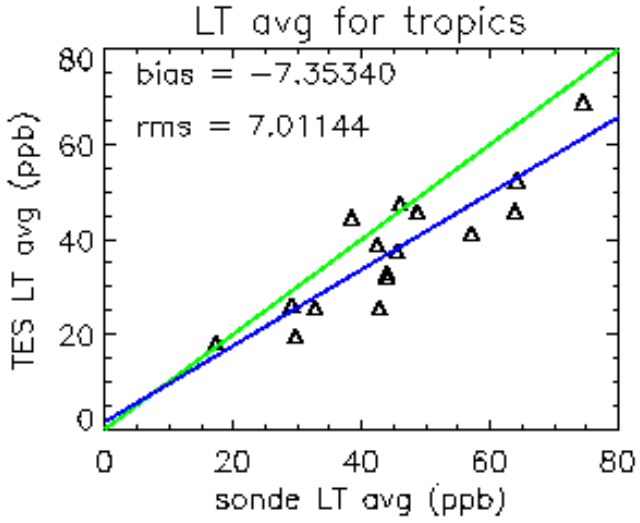
Green - 1:1
Blue - LS fit

Lower Trop (LT)
p > 500mb









28 coincidences

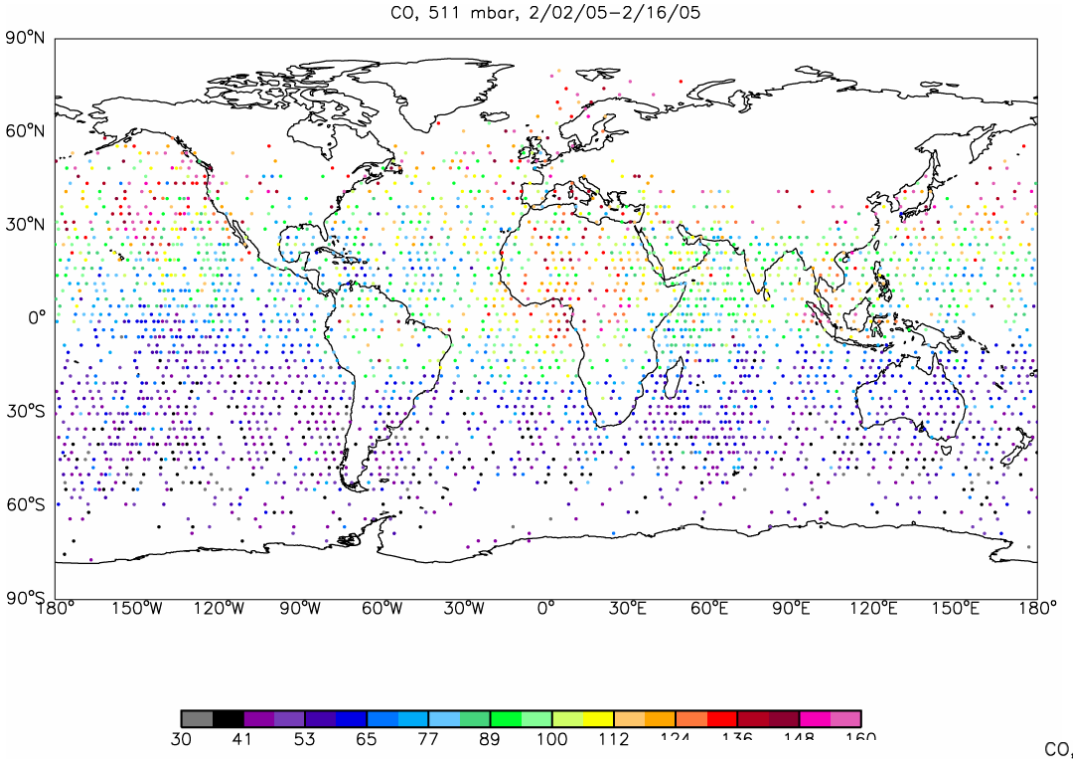
16 coincidences

Validation for current TES data at DAAC (v1, beta quality) shows:

- **TES is able to detect expected variability in the lower troposphere.**
- **Bias in the upper troposphere is:**
  - **latitude dependent**
  - **peaked at 200 - 150 hPa**

Comparisons for data with new, improved L1B calibration (only 3 cases) show less bias in the UT.

The next version should be most useful for GMI



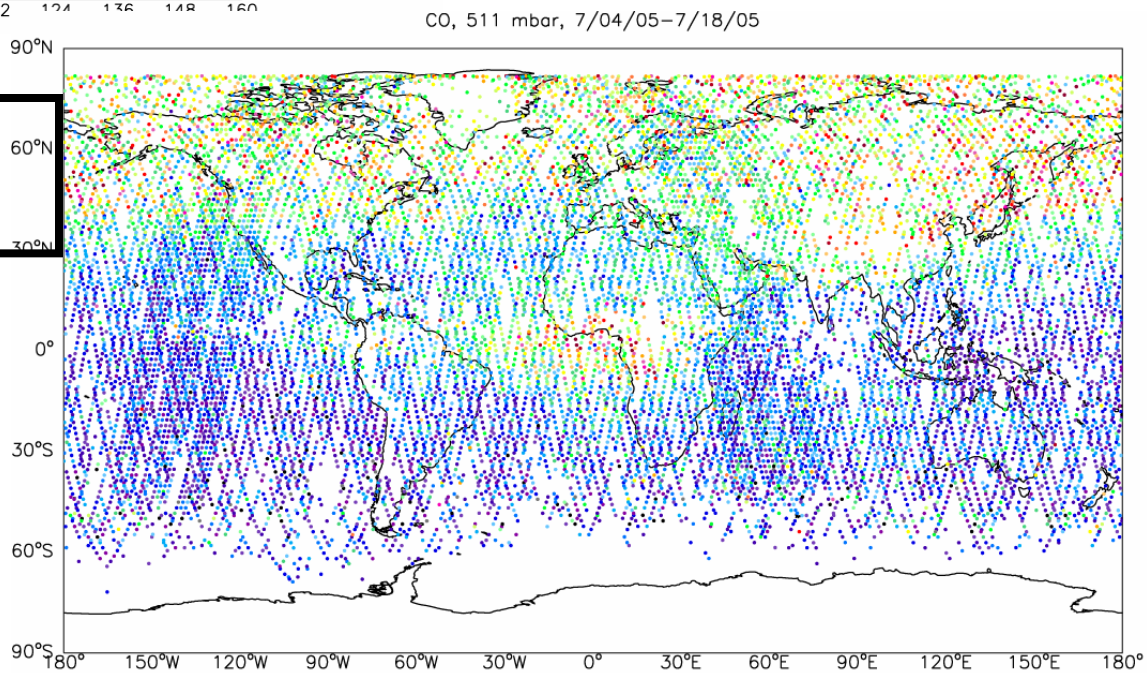
Comparison of data coverage February and July

CO at 511 mb

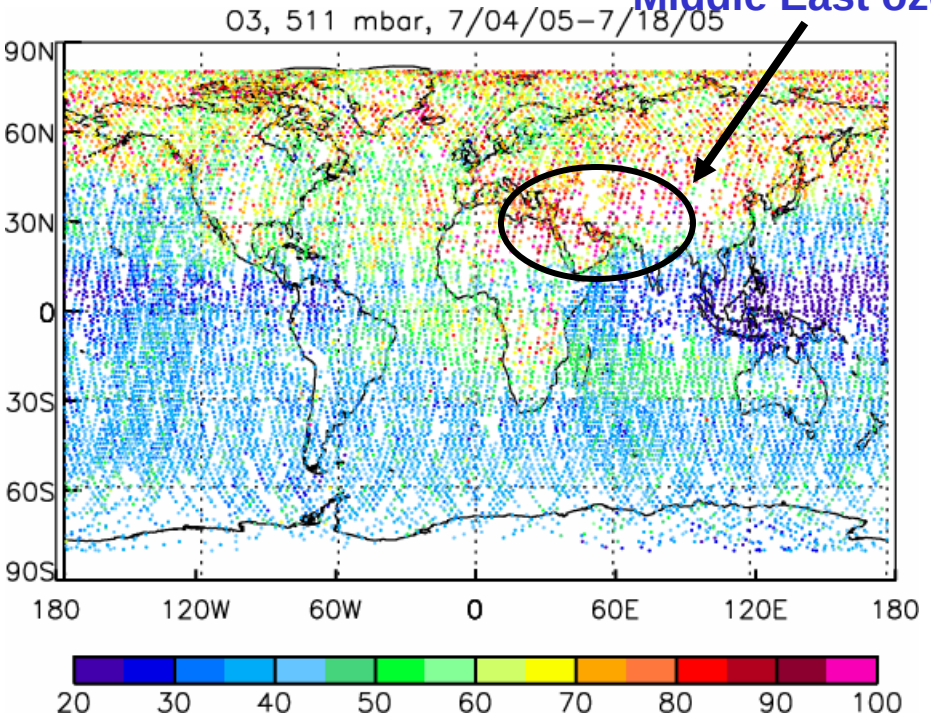
FEB. 2-16

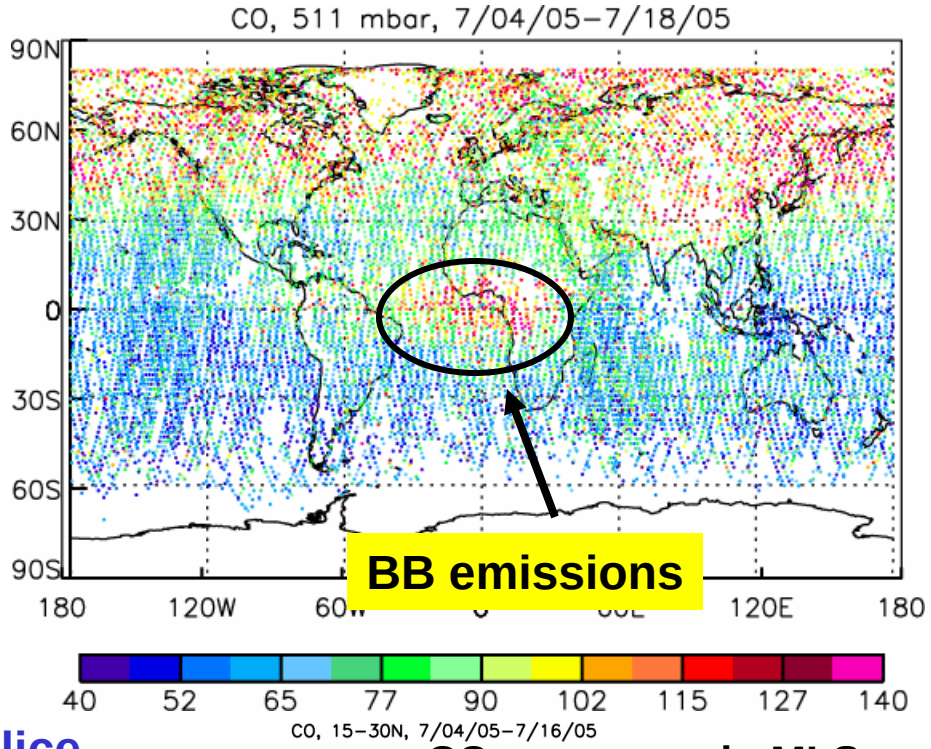
Footprint is 5x8 km, so dots are highly enlarged

JULY 4-16



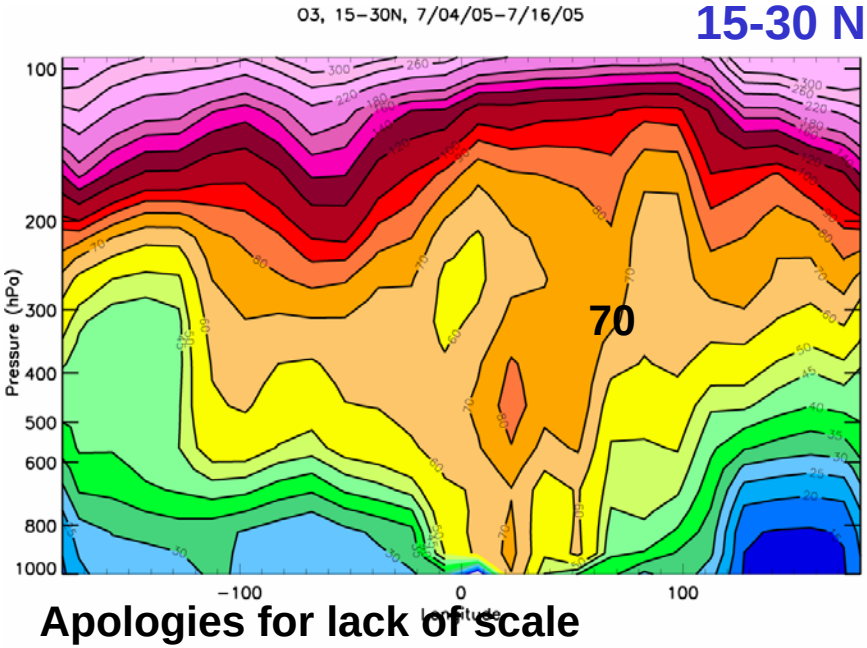
Middle East ozone max?



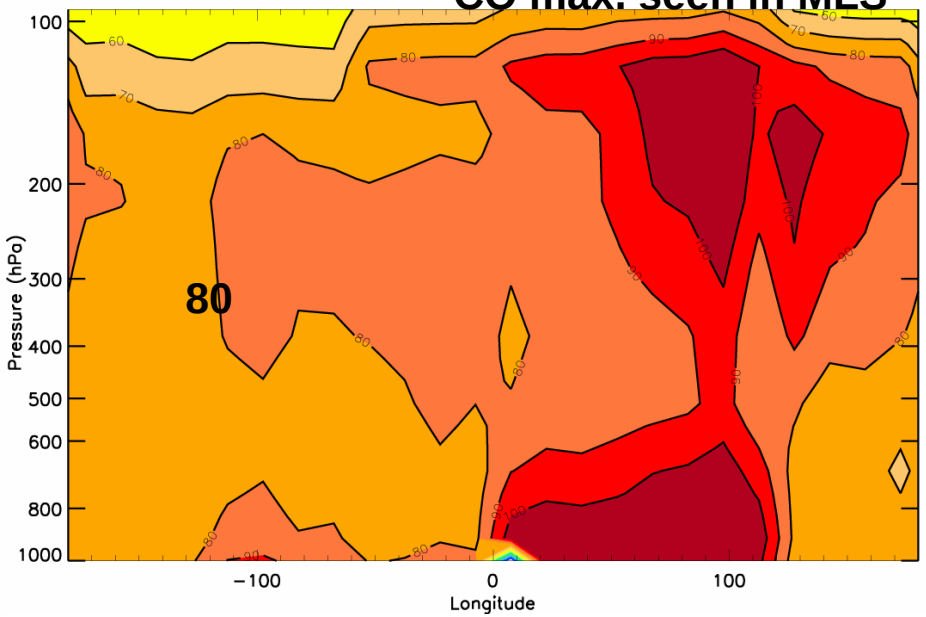


BB emissions

15-30 N slice

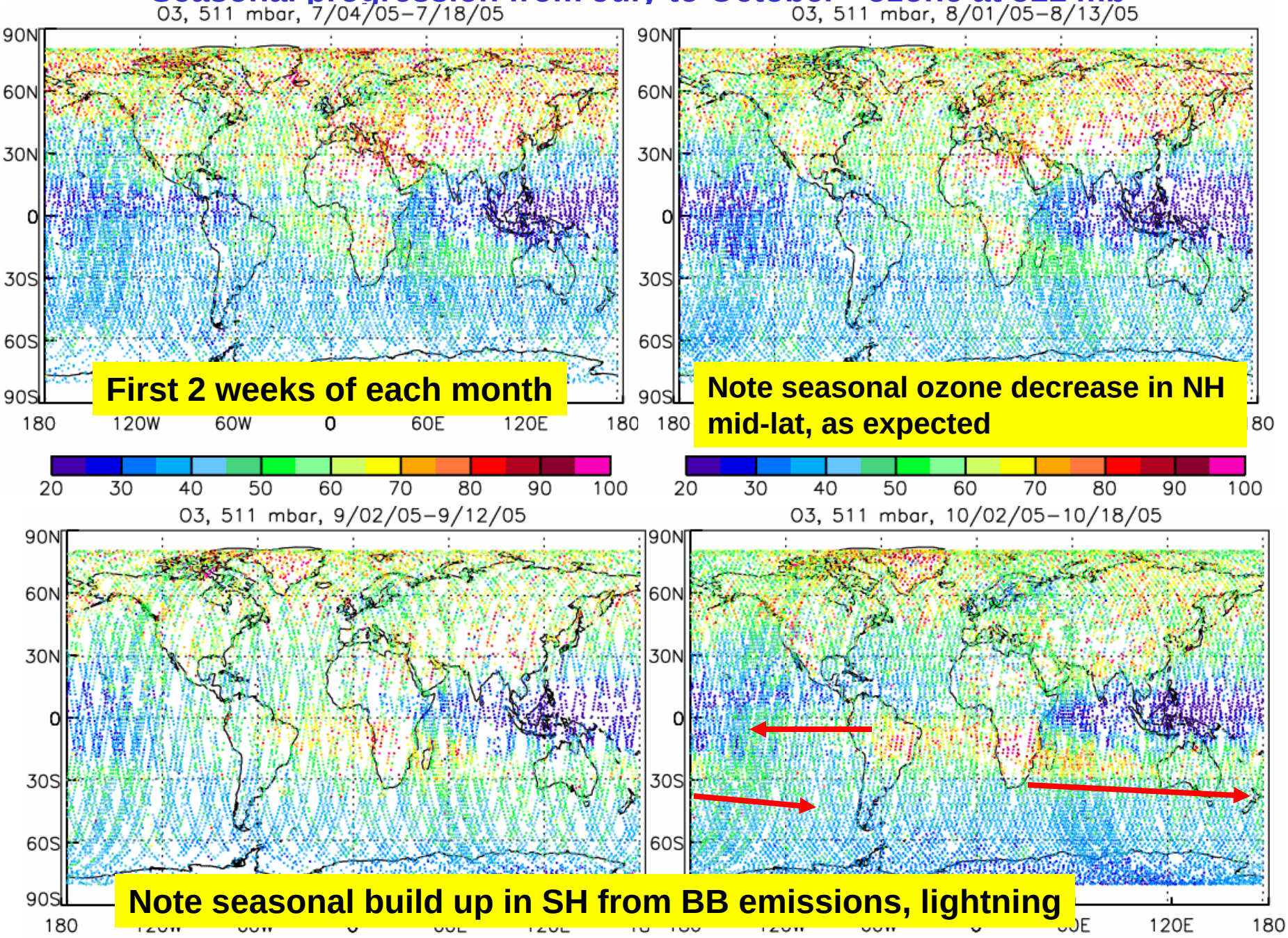


CO max. seen in MLS

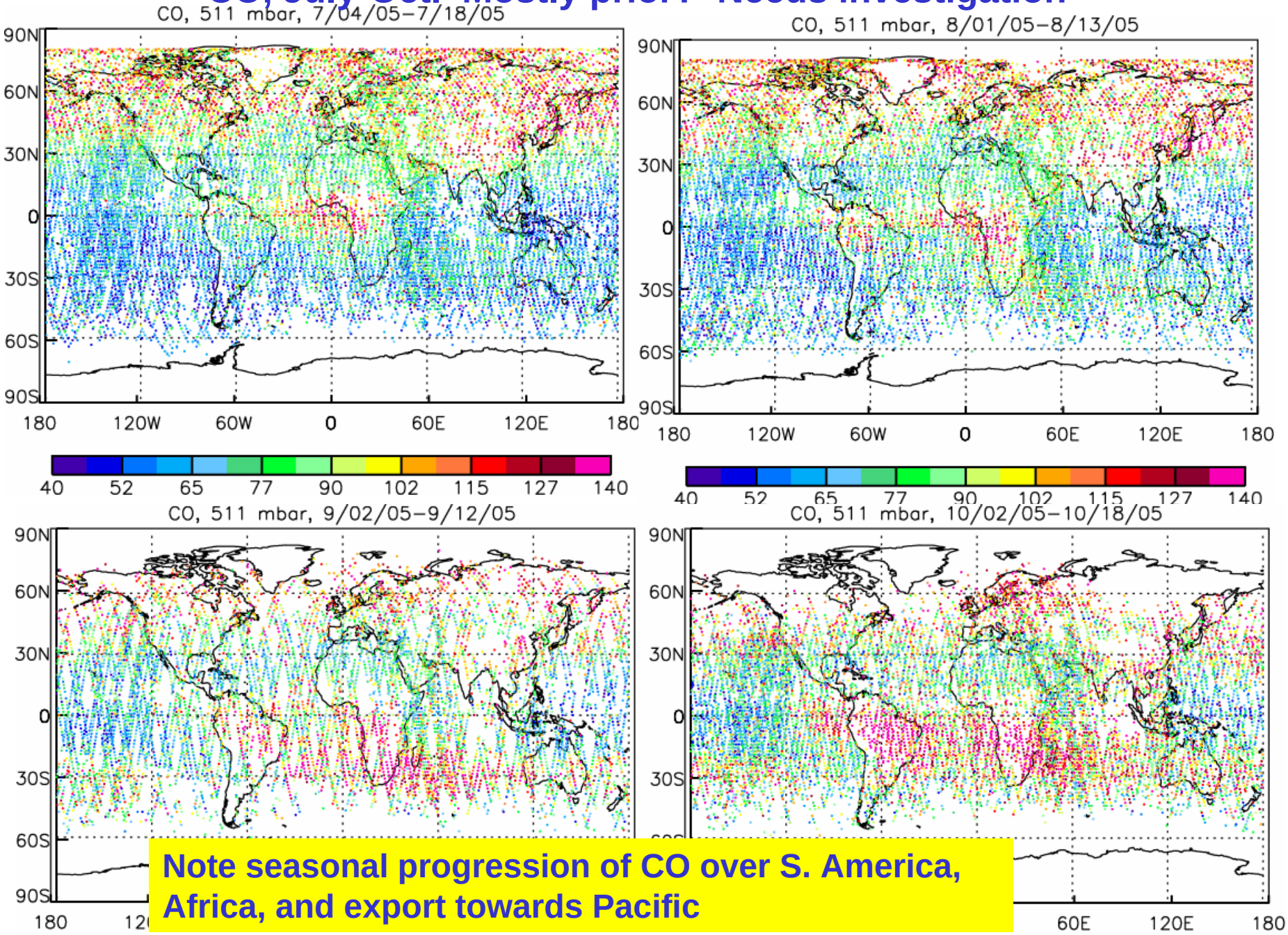


Apologies for lack of scale

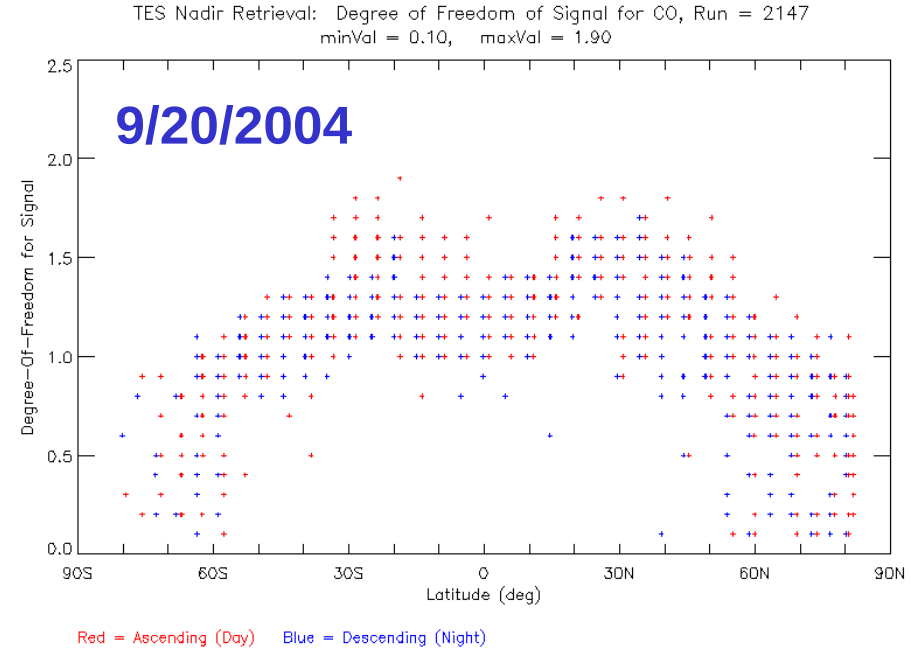
Seasonal progression from July to October - ozone at 511 mb



CO, July-Oct. Mostly prior? Needs investigation



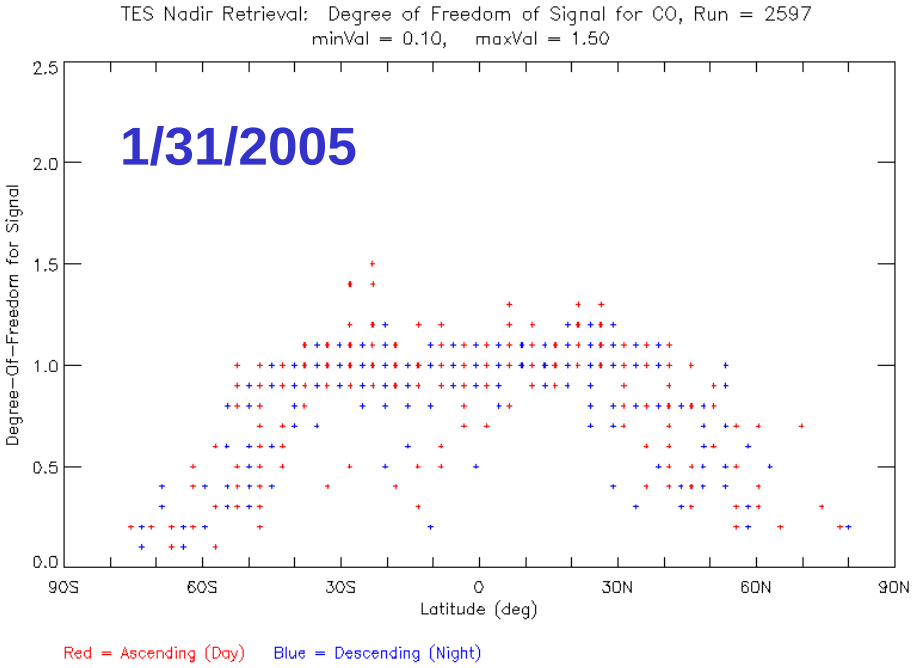
Note seasonal progression of CO over S. America, Africa, and export towards Pacific

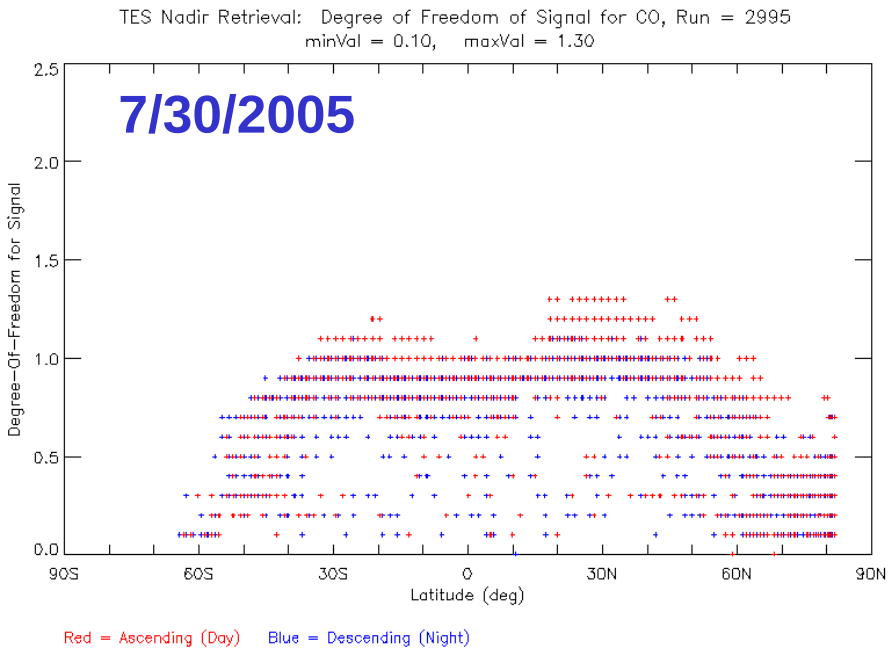


DOF of signal for CO

Note decrease with time

Interpret CO plots that follow with caution

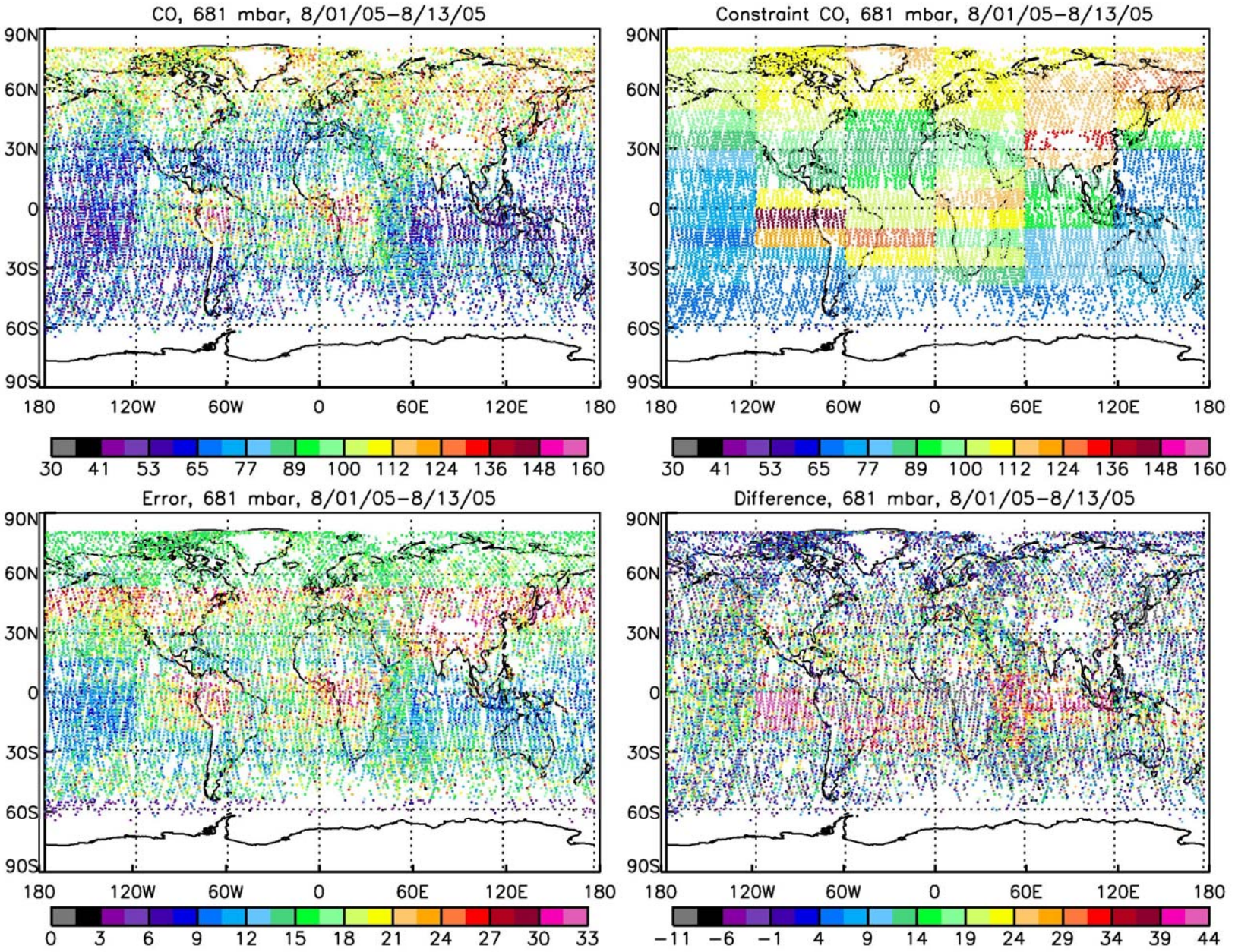




WORST CASE, 511 mb is better

CO 681 mb

Prior, from MOZART, 10 x 60 deg avg.



- **Combo model ideal for analyzing TES data, as averaging kernels span UT/LS**
- **Also ideal for MLS UT/LS data**

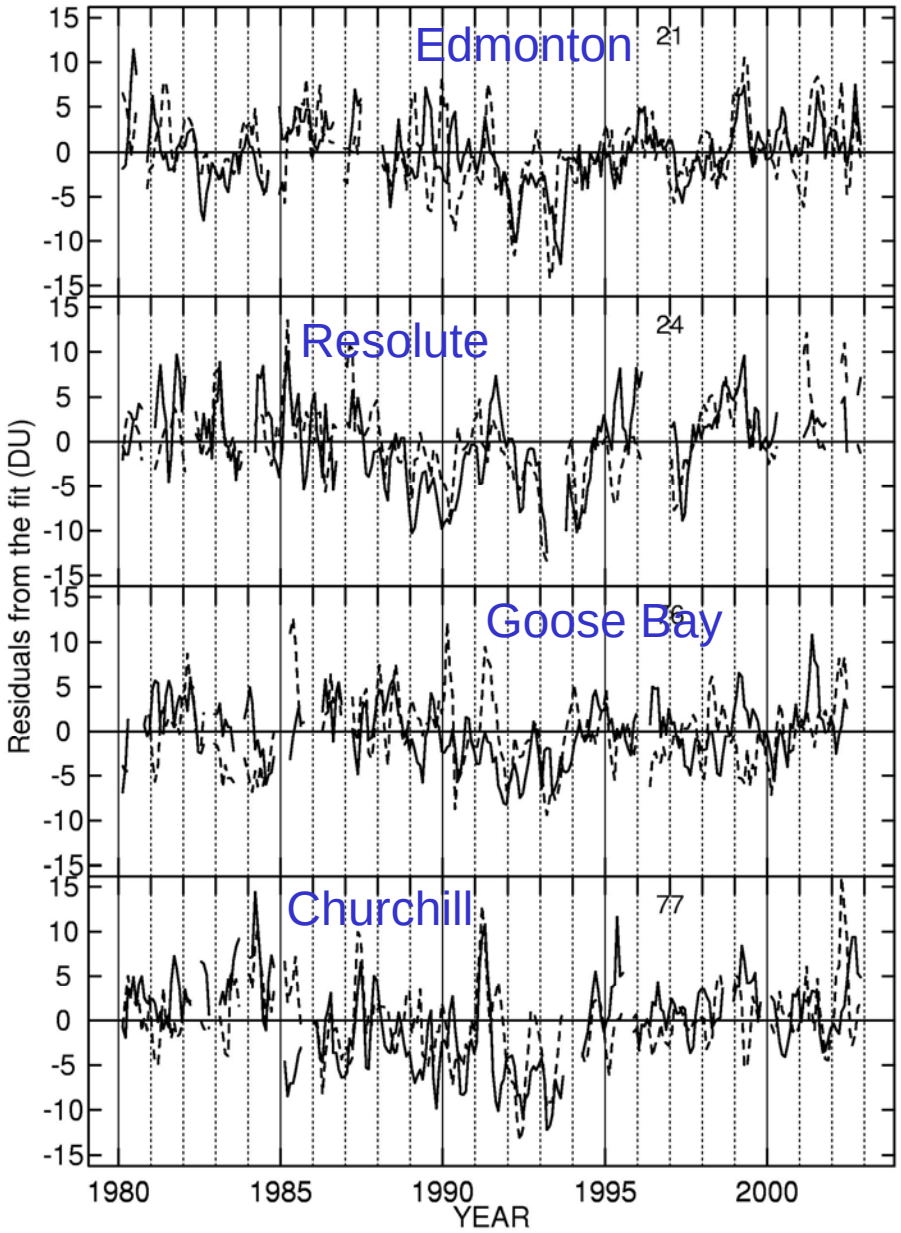
- **Forecast model**

- **Require biomass burning emissions for appropriate period**
  - **Van der Werf (2006) approach based on MODIS fire counts is a possible candidate**
- **Lightning source parameterization?**

What is the role of strat. ozone trends, interannual variability on trop. ozone trends, variability

- **Can we hindcast tropospheric ozone trends?**
- **Analysis of sonde data shows that ozone in the middle troposphere is correlated with ozone in the lower stratosphere**
- **Analysis of GEOS 50 year run shows similarities to correlations in observations**

Ozone residuals at 200 hPa (dashed) and 500 hPa (solid, x5), Canada



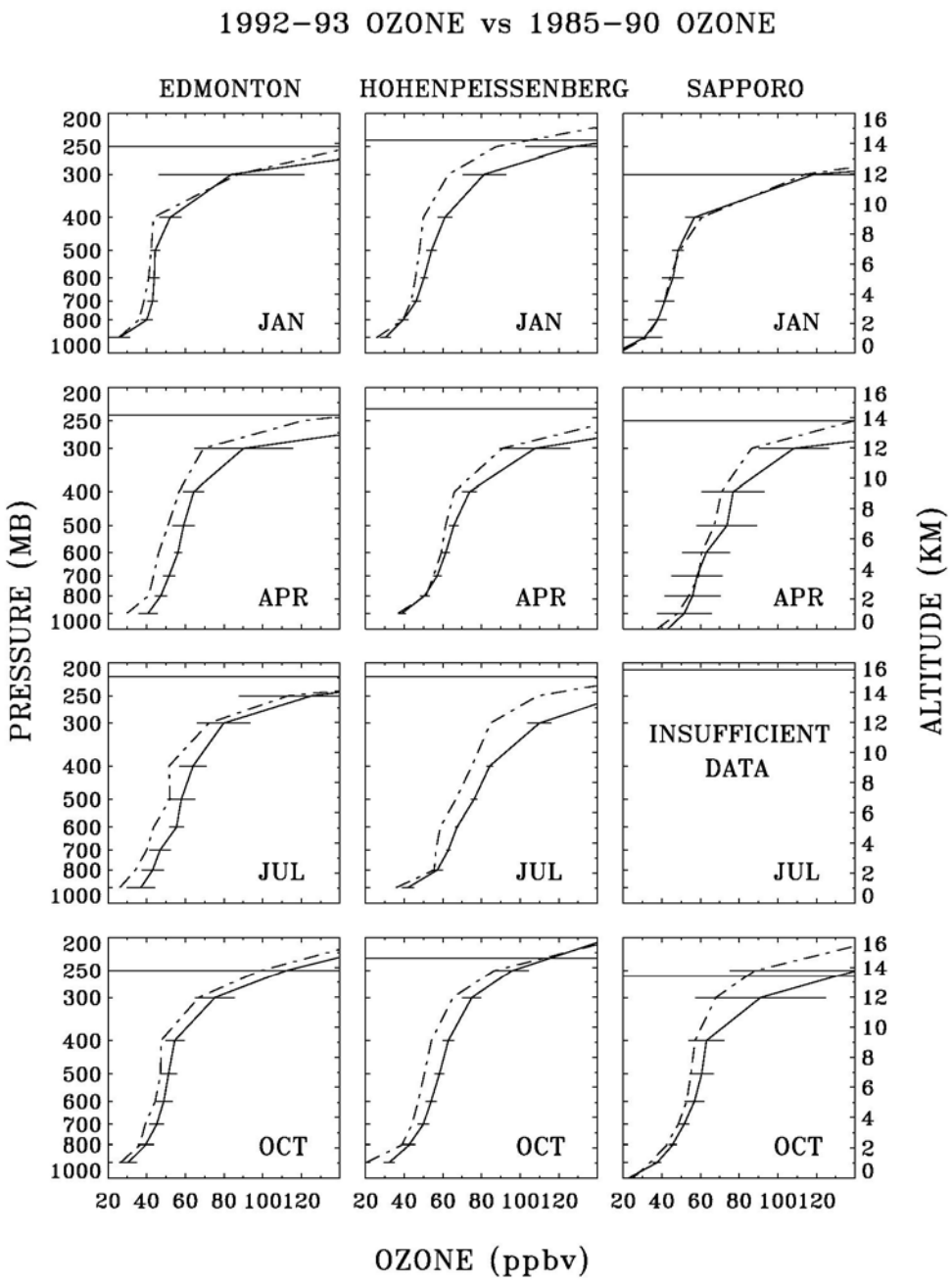
Ozone at 200 and 500 hPa are correlated

- 3 month smoothing shown.
- Trop. ozone will not necessarily correlate with local ozone.

Corr. Coeff. = 0.23-0.53 (smoothed)
Corr. Coeff. = 0.16-0.4 (not smoothed)

For European stations:
Corr. Coeff. = 0.23-0.32 (smoothed)
Corr. Coeff. = 0.21-0.25 (not smoothed)

See also Tarasick et al.



Low trop. ozone post-Pinatubo

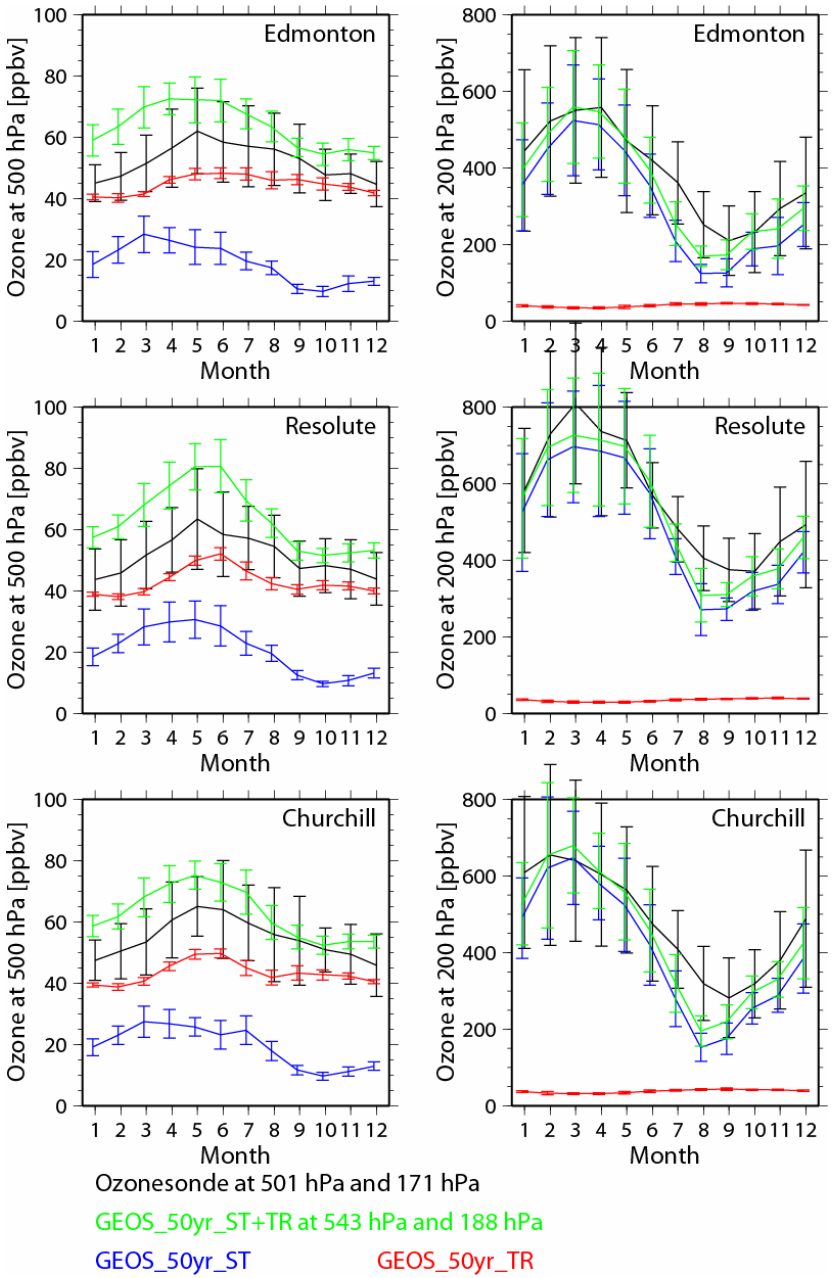
Effect is seen all year.

We showed that changes in strat. ozone can explain some features of trop ozone trends, using GEOS-Chem (GEOS-1) which has a LOW sensitivity to strat. ozone compared to FVGCM

Fusco and Logan, 2003

We examined the correlation between ozone in the LS and trop. using the 50-year GEOS run provided by R. Stolarski and A, Douglass:

- **Strat. chemistry in stratosphere**
- **Production rates and loss frequencies for trop. ozone from GEOS-Chem**
- **Trop. chemistry the same every year**
- **Convection the same every year (a fudge, as original 50 yr run had no convection)**
- **Separate tracers for Strat. and Trop. ozone**



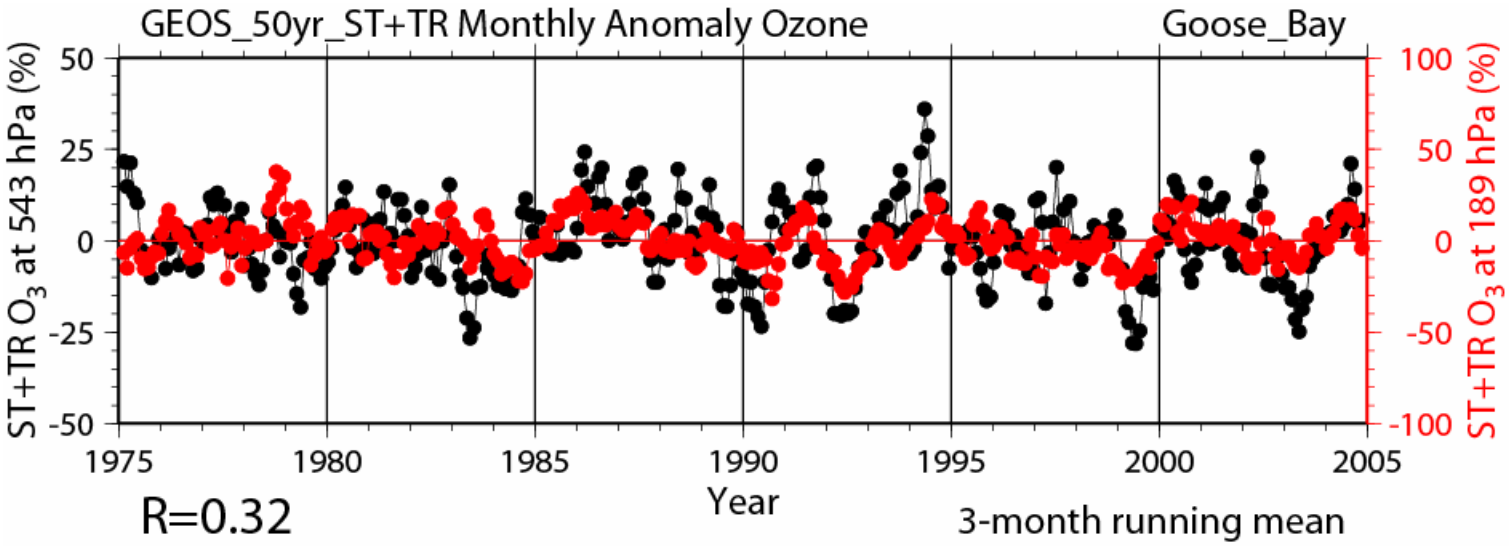
Strat. and Trop. contributions to trop. ozone at sonde sites.

Separate tracers allow this differentiation

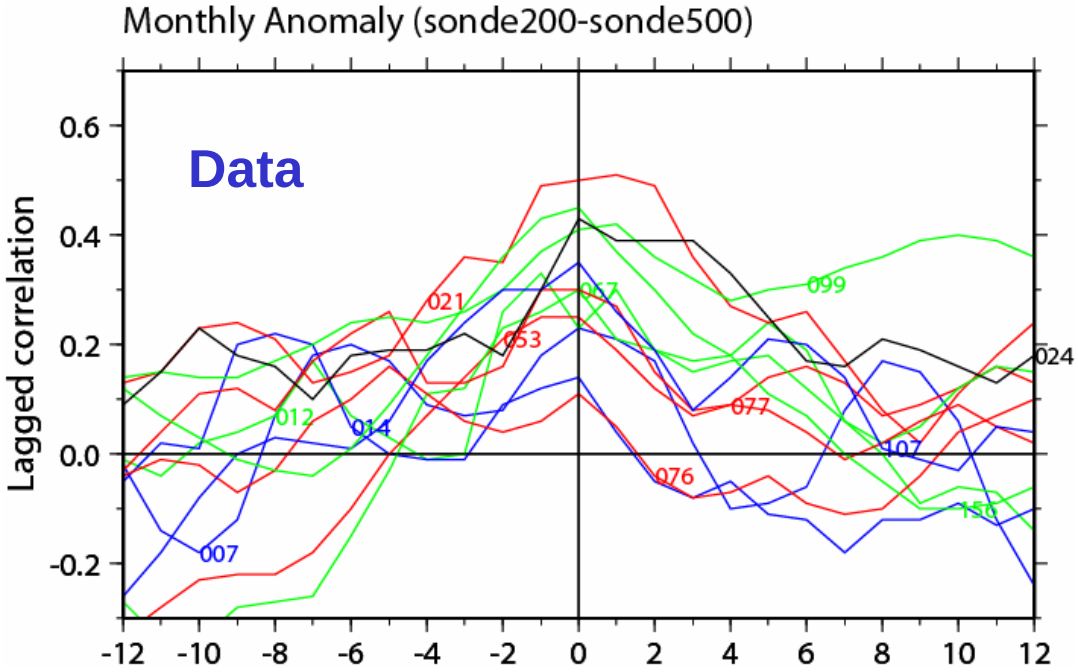
Ozone time series at location of Goose Bay

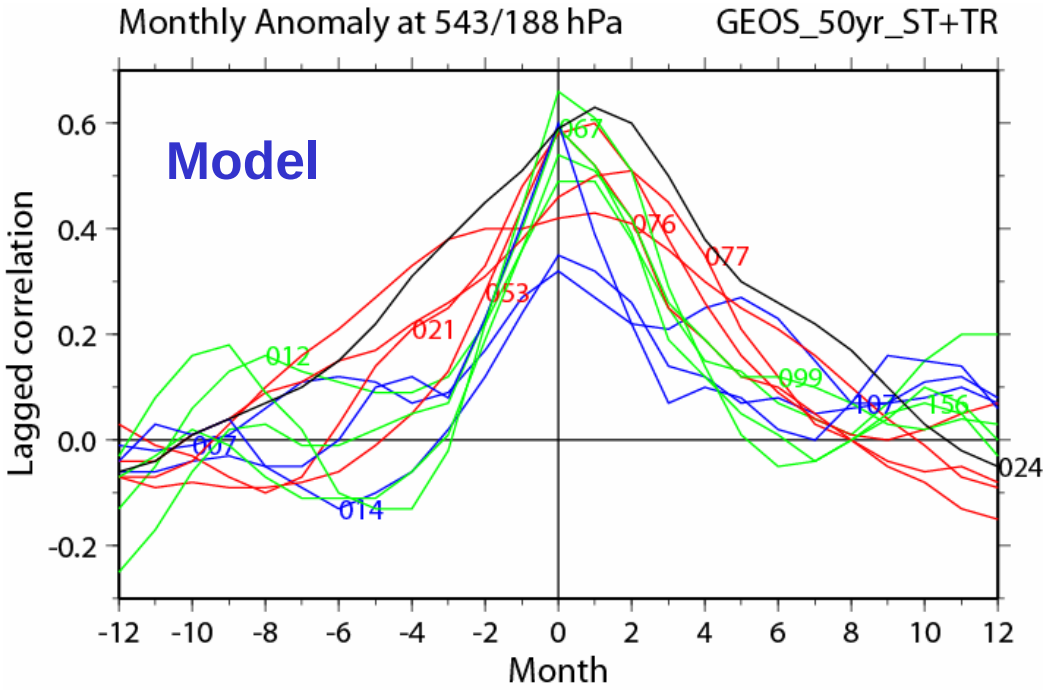
Red: 540 hPa

Black: 189 hPa



Lagged correlation at sonde sites





- **Correlation higher in model than in data.**
- **The model may have too much strat. influence based on comparisons of 2 tracers with observations**

Proposed Combo simulations to investigate effects of changes in stratospheric ozone flux on trop. ozone

- Simulations for early 1970s and mid-1990s (halogens, SST's, trop. emissions, etc), several years.
  - Ozone in the LMS changed by ~25% in this period
- Conduct runs for warm and cold Arctic winters
- Archive daily prod. rates and loss frequencies of ozone (odd-O)
- Use these to diagnose ozone of strat. and trop. origin
- I assume colleagues at GSFC will be looking at the STE fluxes